

AMENDMENTS TO THE CLAIMS

1. (currently amended) A two-stage method for characterizing a spatial arrangement among data points for each of a plurality of three-dimensional time series distributions comprising a sparse number of said data points, said method comprising the steps of:

creating a first virtual volume containing a first three-dimensional time series distribution of said data points to be characterized;

subdividing said first virtual volume into a plurality k of three-dimensional volumes, each of said plurality k of three-dimensional volumes having the same shape and size;

providing a first stage characterization of said spatial arrangement of said first three-dimensional time series distribution of said data points comprising the steps of[[;]]:

determining a statistically expected proportion Θ of said plurality k of three-dimensional volumes containing at least one of said data points for a random distribution of said data points such that k

* Θ is a statistically expected number $[[M]]$ of said plurality k of three-dimensional volumes which contain at least one of said data points if said first three-dimensional time series distribution is characterized as random;

counting a number m of said plurality k of three-dimensional volumes which actually contain at least one of said data points in said first three-dimensional time series distribution, wherein M is the symbolic alphabetical character assigned to be the parameter representing $k * \Theta$ in mathematical statements and m is a representation of M in a given spatial arrangement undergoing processing in accordance with the method;

statistically determining an upper random boundary \underline{m}_2 greater than M and a lower random ~~barrier~~ boundary \underline{m}_1 less than M such that if said number m is between said upper random ~~barrier~~ boundary and said lower random barrier then said first three-dimensional time series distribution is characterized as random in structure during said first stage characterization;

providing a second stage characterization of said first
three-dimensional time series distribution of said data
points comprising the steps of[[;]]:

when Θ is less than a pre-selected value, then utilizing
a Poisson distribution to determine a first mean of
said data points;

when Θ is greater than said pre-selected value, then
utilizing a binomial distribution to determine a
second mean of said data points;

computing a probability p from said first mean or from
said second mean depending on whether Θ is greater
than or less than said pre-selected value;

determining a false alarm probability α based on a total
number of said plurality k of three-dimensional
volumes for said first three-dimensional time
series distribution of said data points to be
characterized;

comparing p with α to determine whether to characterize
said sparse number of said data points as noise or
signal during said second stage characterization;
and

comparing said first stage characterization of said first
three-dimensional time series distribution of said data
points with said second stage characterization of said
first three-dimensional time series distribution of said
data points to determine presence of randomness in said
first three-dimensional time series distributions
distribution.

2. (currently amended) The two-stage method of claim 1, wherein
if said first stage characterization of said first three-
dimensional time series distribution of said data points indicates
a random distribution and said second stage characterization of
said first three-dimensional time series distribution of said data
points indicates a signal, then ~~continuing~~ continue to process
said data points.

3. (currently amended) The two-stage method of claim 1, wherein
if said first stage characterization of said first three-
dimensional time series distribution of said data points indicates

a random distribution and said second stage characterization of said first three-dimensional time series distribution of said data points indicates a random distribution, then labeling said first three-dimensional time series distribution of said data points as random.

4. (currently amended) The two-stage method of claim 1, further comprising utilizing the method steps of claim 1 for characterizing each of said plurality of three-dimensional time series ~~distribution~~ distributions of said data points.

5. (currently amended) The two-stage method of claim 1, wherein said first three-dimensional time series distribution of said data points comprises less than about twenty-five (25) data points.

6. (currently amended) The two-stage method of claim 1, wherein said upper random boundary greater than M and said lower random barrier less than M are computed utilizing binomial probabilities.

7. (currently amended) The two-stage method of claim 1, further comprising obtaining each of said plurality of three-dimensional time series distributions comprising said sparse number of said data points from a sonar system.

8. (currently amended) The two-stage method of claim 1, further comprising obtaining each of said plurality of three-dimensional time series distributions comprising said sparse number of said data points from a radar system.

9. (currently amended) The two-stage method of claim 1, further comprising determining said false alarm probability α based on a total number of said plurality k of three-dimensional volumes for said first three-dimensional time series distribution of said data points to be characterized wherein:

$$\alpha = 0.01 \text{ if } k \geq 25, \text{ and} \\ \alpha = 0.05 \text{ if } k < 25.$$

10. (currently amended) The two-stage method of claim 1, wherein said step of comparing p with α to determine whether to characterize said sparse number of said data points as noise or signal during said first stage characterization is mathematically stated as:

$$\text{if } p \geq \alpha \Rightarrow \text{NOISE, and} \\ \text{if } p < \alpha \Rightarrow \text{SIGNAL.}$$

11. (currently amended) The two-stage method of claim 1, wherein said pre-selected value is equal to 0.10 such that if

$\Theta \leq 0.10$, then said Poisson distribution is utilized, and if

$\Theta > 0.10$, then said binomial distribution is utilized.

12. (currently amended) The two-stage method of claim 1, wherein

a total number Y of said data points is given by $Y = \sum_{k=0}^K kN_k$, where:

k (number of cells with points)	N_k (number of points in k cells)
0	N_0
1	N_1
2	N_2
3	N_3
\vdots	\vdots
\underline{K}	N_k

13. (currently amended) The two-stage method of claim 12, wherein said step of computing said probability p from said first mean further comprises utilizing the following equation:

$$p = P(|z_p| \leq Z) = 1 - \frac{1}{\sqrt{2\pi}} \int_{-|z_p|}^{+|z_p|} \exp(-.5x^2) dx$$

$$p = P(|z_p| \leq Z) = 1 - \frac{1}{\sqrt{2\pi}} \int_{-|z_p|}^{+|z_p|} \exp(-.5x^2) dx$$

$$\text{where } Z_p = \frac{Y - N\mu_0}{\sqrt{N\mu_0}} \quad \underline{Z_P = \frac{Y - N\mu_0}{\sqrt{N\mu_0}}}$$

where P refers to probability,

where Z is the theoretical Gaussian continuous probability distribution,

where X is the "dummy variable" of integration in the integrand,

where Y is said total number of data points,

where, N is a sample size of said data points for each of a plurality of three-dimensional time series distributions, and

$$\mu_0 = \frac{\sum_{k=0}^K kN_k}{\sum_{k=0}^K N_k} \quad \underline{\mu_0 = \frac{\sum_{k=0}^K kN_k}{\sum_{k=0}^K N_k}} \text{ is said first mean.}$$

14. (currently amended) [[A]] The two-stage method according to claim 13, wherein said step of computing said probability p from said second mean further comprises utilizing the following equation:

$$p = P(|z_B| \leq Z) = 1 - \frac{1}{\sqrt{2\pi}} \int_{-|z_B|}^{+|z_B|} \exp(-.5x^2) dx$$

$$p = P(|z_B| \leq Z) = 1 - \frac{1}{\sqrt{2\pi}} \int_{-|z_B|}^{+|z_B|} \exp(-.5x^2) dx$$

$$\text{where } z_B = \frac{m \pm c - k\theta}{\sqrt{k\theta(1-\theta)}} \quad \underline{z_B = \frac{m \pm c - k\theta}{\sqrt{k\theta(1-\theta)}}}$$

where c is a correction factor.

15. (currently amended) The two-stage method of claim [[1]] 12, wherein said plurality k of three-dimensional volumes into which said first virtual volume is subdivided is determined from the relation

$$k = \begin{cases} k_I & \text{if } K_I > K_{II} \\ k_{II} & \text{if } K_I < K_{II} \\ \max(k_I, k_{II}) & \text{if } K_I = K_{II} \end{cases}, \quad \underline{k = \begin{cases} k_I & \text{if } K_I > K_{II} \\ k_{II} & \text{if } K_I < K_{II} \\ \max(k_I, k_{II}) & \text{if } K_I = K_{II} \end{cases}} \quad \text{where}$$

$$k_I = \text{int} \left(\frac{\Delta t}{\delta_I} \right) * \text{int} \left(\frac{\Delta Y}{\delta_I} \right) * \text{int} \left(\frac{\Delta Z}{\delta_I} \right), \quad \underline{k_I = \text{int} \left(\frac{\Delta t}{\delta_I} \right) * \text{int} \left(\frac{\Delta Y}{\delta_I} \right) * \text{int} \left(\frac{\Delta Z}{\delta_I} \right)}$$

$$k_{II} = \text{int} \left(\frac{\Delta t}{\delta_{II}} \right) * \text{int} \left(\frac{\Delta Y}{\delta_{II}} \right) * \text{int} \left(\frac{\Delta Z}{\delta_{II}} \right), \quad \underline{k_{II} = \text{int} \left(\frac{\Delta t}{\delta_{II}} \right) * \text{int} \left(\frac{\Delta Y}{\delta_{II}} \right) * \text{int} \left(\frac{\Delta Z}{\delta_{II}} \right)}$$

$$\delta_I = \sqrt[3]{\frac{\Delta t * \Delta Y * \Delta Z}{k_0}},$$

$$\delta_I = \sqrt[3]{\frac{\Delta t * \Delta Y * \Delta Z}{k_0}} \perp$$

$$k_0 = \begin{cases} k_1 & \text{if } |N - k_1| \leq |N - k_2| \\ k_2 & \text{otherwise} \end{cases},$$

$$k_0 = \begin{cases} k_1 & \text{if } |N - k_1| \leq |N - k_2| \\ k_2 & \text{otherwise} \end{cases} \perp$$

$$k_1 = \left[\text{int} \left(N^{\frac{1}{3}} \right) \right]^3,$$

$$k_1 = \left[\text{int} \left(N^{\frac{1}{3}} \right) \right]^3 \perp$$

$$k_2 = \left[\text{int} \left(N^{\frac{1}{3}} \right) + 1 \right]^3,$$

$$k_2 = \left[\text{int} \left(N^{\frac{1}{3}} \right) + 1 \right]^3 \perp$$

$$\delta_{II} = \sqrt[3]{\frac{\Delta t * \Delta Y * \Delta Z}{N}},$$

$$\delta_{II} = \sqrt[3]{\frac{\Delta t * \Delta Y * \Delta Z}{N}} \perp$$

$$K_I = \frac{k_I}{\Delta t * \Delta Y * \Delta Z} \delta_I^3 \leq 1,$$

$$K_I = \frac{k_I}{\Delta t * \Delta Y * \Delta Z} \delta_I^3 \leq 1 \perp$$

$$K_{II} = \frac{k_{II}}{\Delta t * \Delta Y * \Delta Z} \delta_{II}^3 \leq 1,$$

$$K_{II} = \frac{k_{II}}{\Delta t * \Delta Y * \Delta Z} \delta_{II}^3 \leq 1 \perp$$

N is the Maximum number of data points in the distribution,

Δt is time interval for collecting each of said plurality of three-dimensional time series distributions,

$\Delta Y = \max(Y) - \min(Y)$ where Y is a magnitude of a first measure of said data points between a maximum and minimum value, and a second measure referred to as Z with magnitude $\Delta Z = \max(Z) - \min(Z)$ where Z is

a magnitude of a second measure of said data points between a maximum and minimum value, and

int is the integer operator.